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INT CL[6] G01R 11/00 11/02 11/04 11/24 11/56 11/57 11/58 22/00

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(54) Improvements in or relating to electricity meters

(57) An electricity meter comprises input terminals 22, 23 to which in use a mains electricity supply is connected, output terminals 24, 25 via which in use electricity is fed to a consumer, a switch 26 via which electricity is fed from the input terminals to the output terminals and metering means 27 operative to provide an indication of the quantity of electricity fed via the switch to the consumer. The meter is adapted to receive a unit arranged in operative association with the switch so as to effect operation of a switch actuator to open the switch for the purpose of interrupting the supply of electricity to the consumer consequent upon receipt by the unit of a predetermined actuation signal. As described the unit is a pre-payment or remote reading/control module adapted to fit on a basic meter.

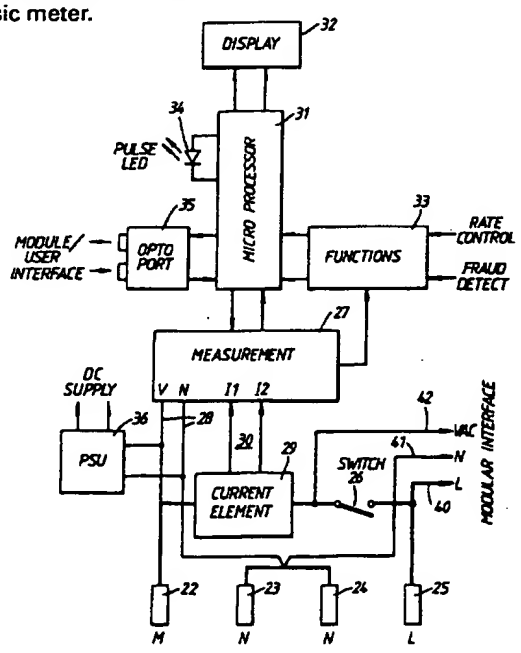

Fig.1F

GB 2 295 681 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

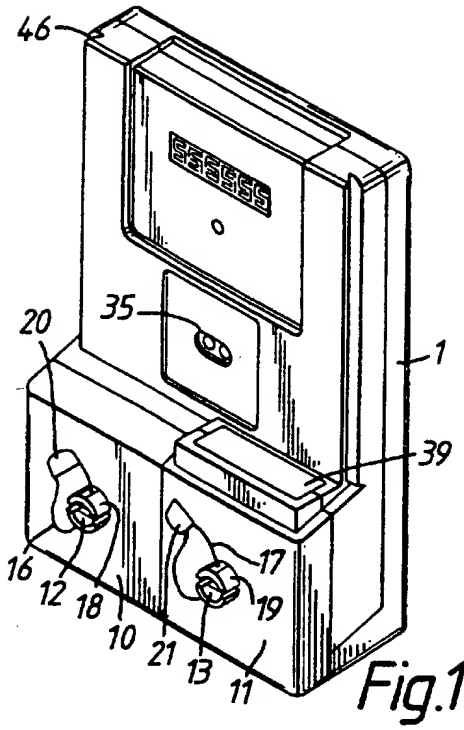

Fig.1a

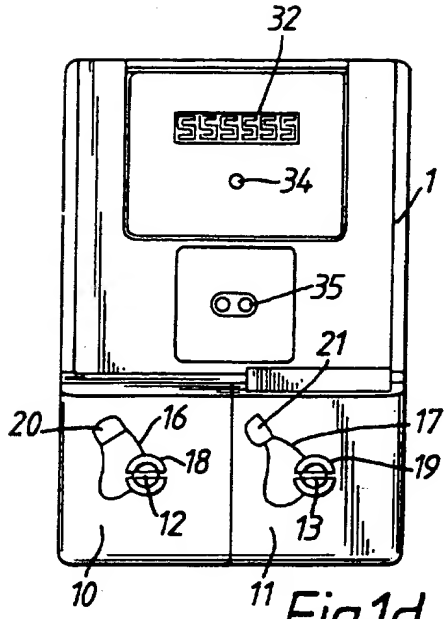

Fig.1d

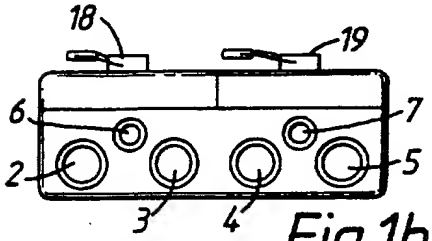

Fig.1b

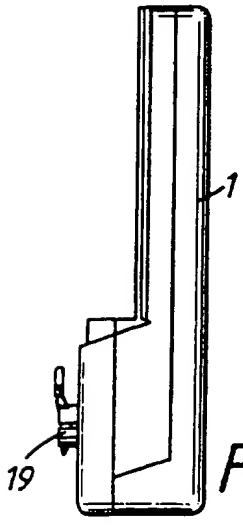

Fig.1c

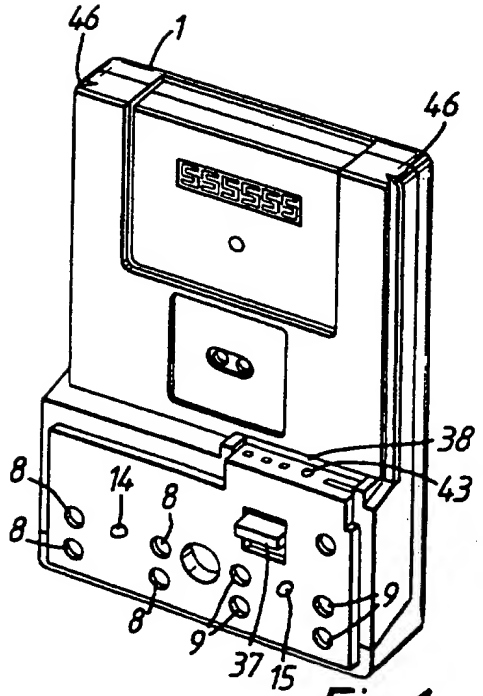

Fig.1e

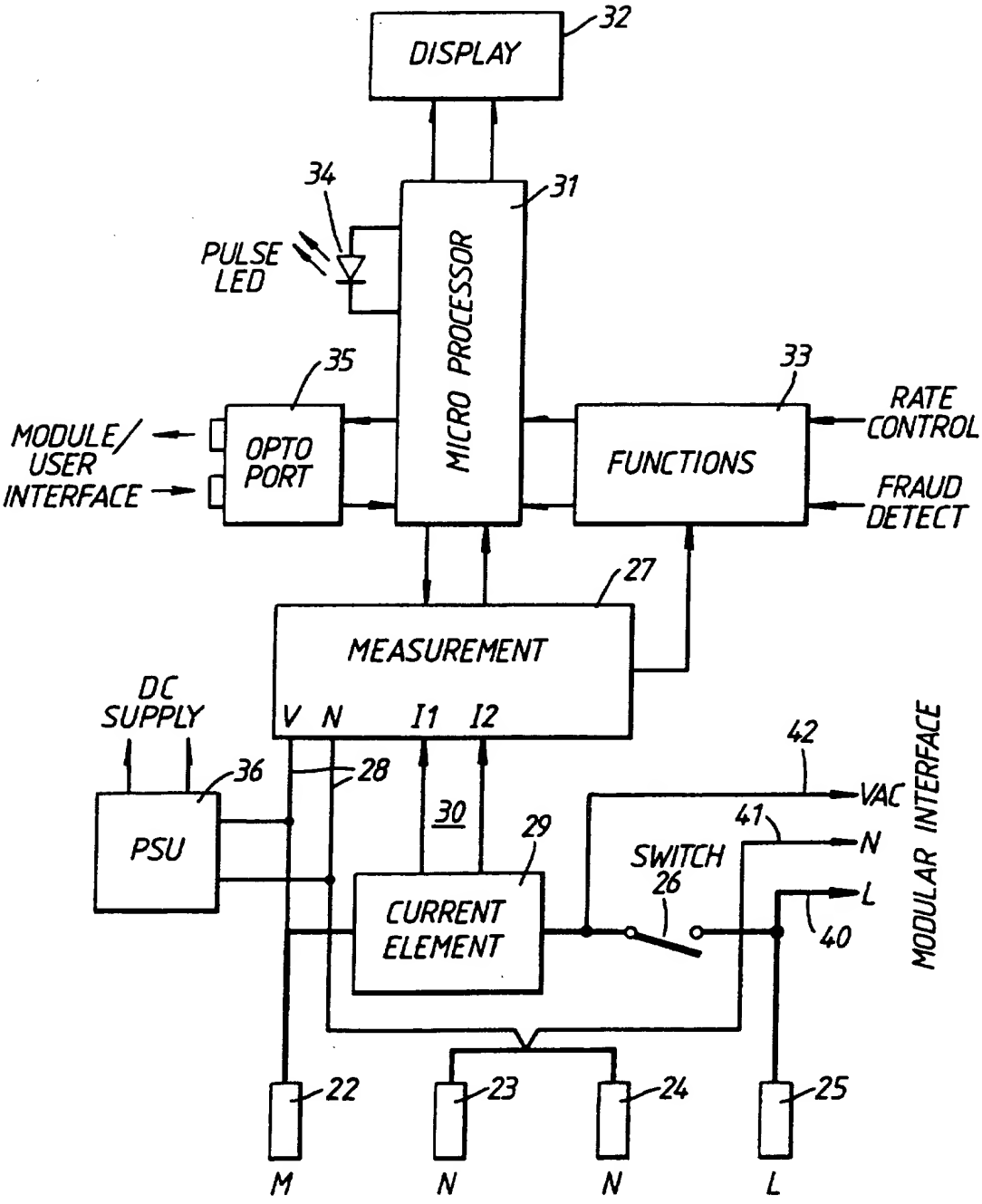
DISPLAY
32
34
31
PULSE LED
MICRO PROCESSOR
35
33
MODULE/ USER INTERFACE
OPTO PORT
FUNCTIONS
RATE CONTROL
FRAUD DETECT
27
MEASUREMENT
V N I1 I2
DC SUPPLY
36
28
42
VAC
41
N
30
29
SWITCH
26
L
PSU
CURRENT ELEMENT
40
MODULAR INTERFACE
22
23
24
25
M
N
N
L

Fig.1F

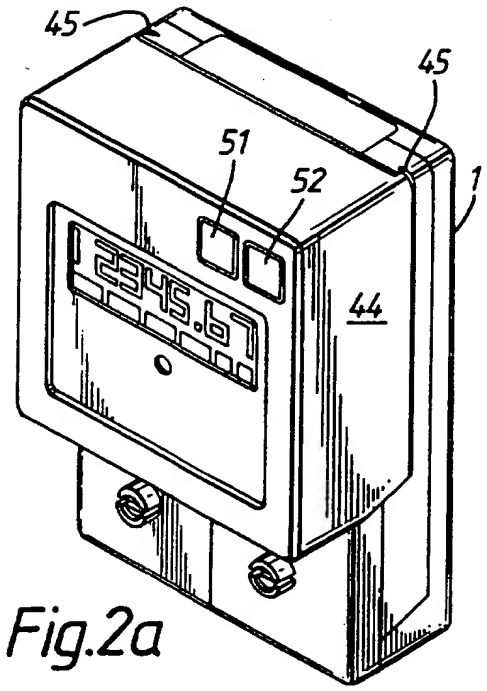

Fig.2a

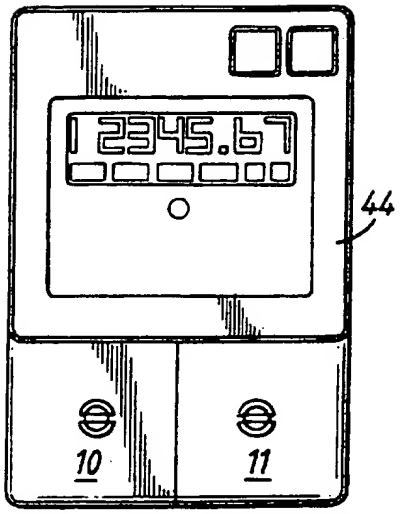

Fig.2d

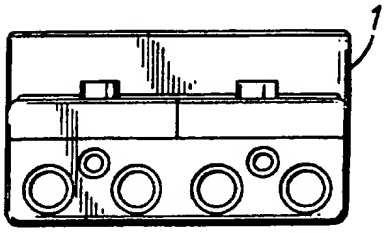

Fig.2b

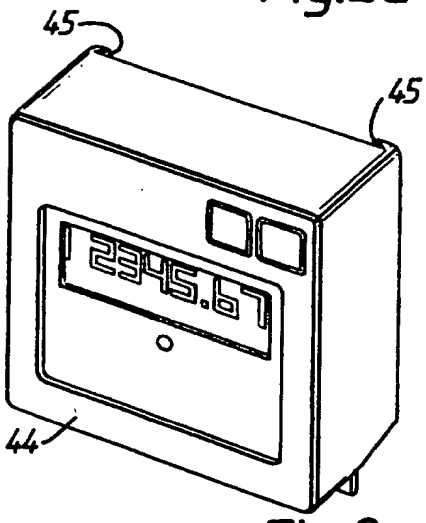

Fig.2e

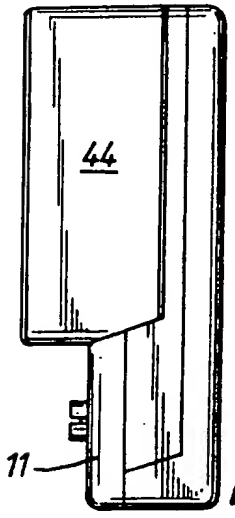

Fig.2c

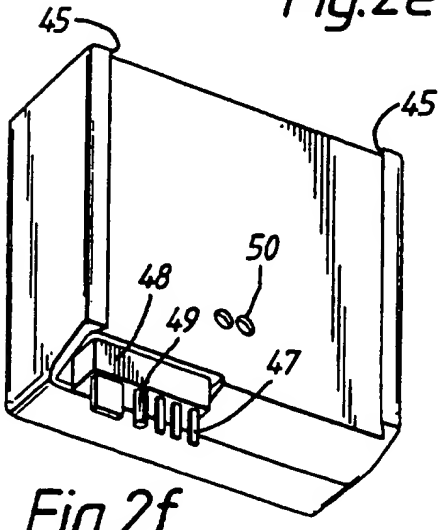

Fig.2f

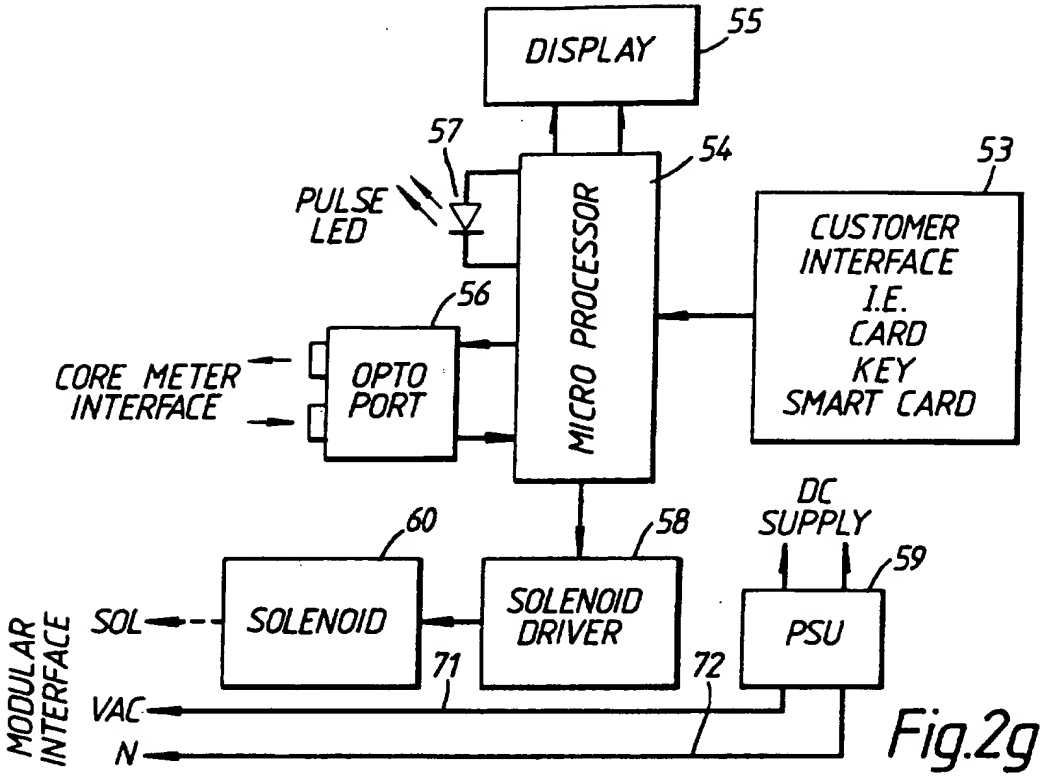
DISPLAY
55
57
PULSE LED
54
MICRO PROCESSOR
53
CUSTOMER INTERFACE I.E. CARD KEY SMART CARD
56
CORE METER INTERFACE
OPTO PORT
DC SUPPLY
60
58
59
SOL
SOLENOID
SOLENOID DRIVER
PSU
MODULAR INTERFACE
71
72
VAC
N

Fig.2g

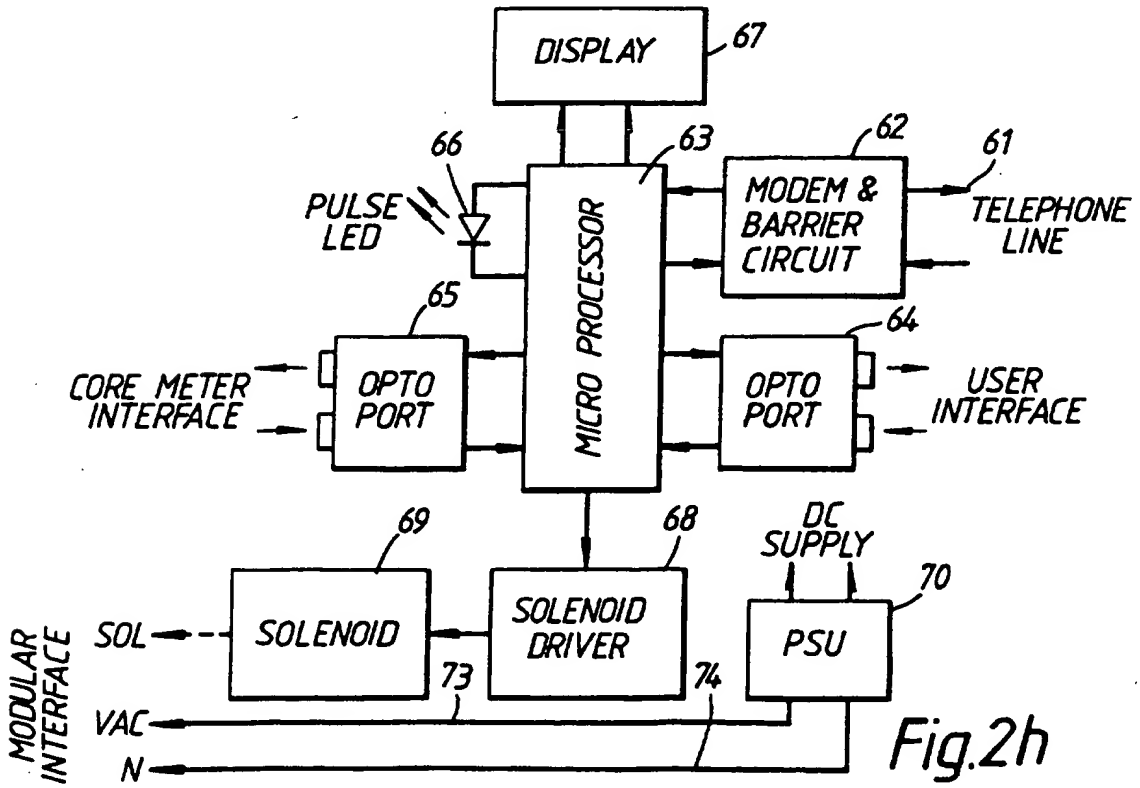
DISPLAY
67
66
63
62
61
PULSE LED
MODEM & BARRIER CIRCUIT
TELEPHONE LINE
MICRO PROCESSOR
65
64
CORE METER INTERFACE
OPTO PORT
OPTO PORT
USER INTERFACE
DC SUPPLY
69
68
70
SOL
SOLENOID
SOLENOID DRIVER
PSU
MODULAR INTERFACE
73
74
VAC
N

Fig.2h

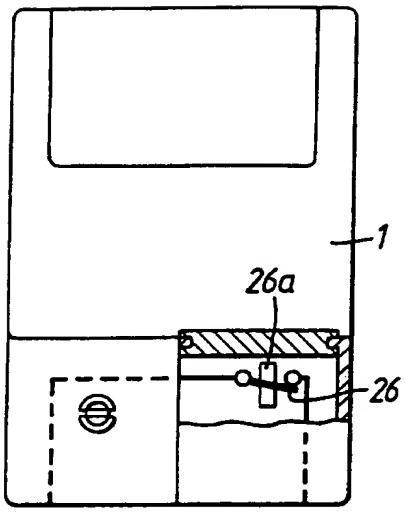

Fig.3a

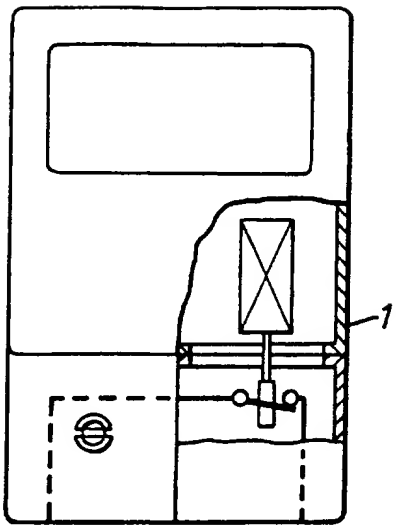

Fig.3c

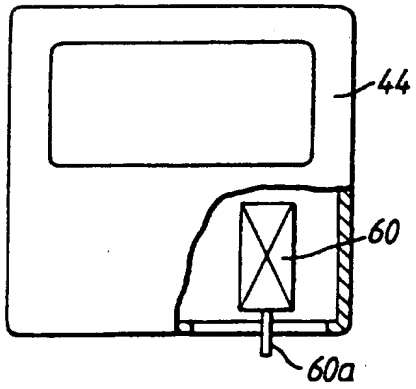

Fig.3b

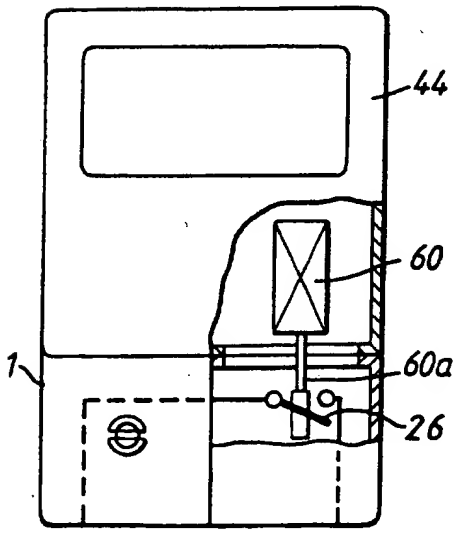

Fig.3d

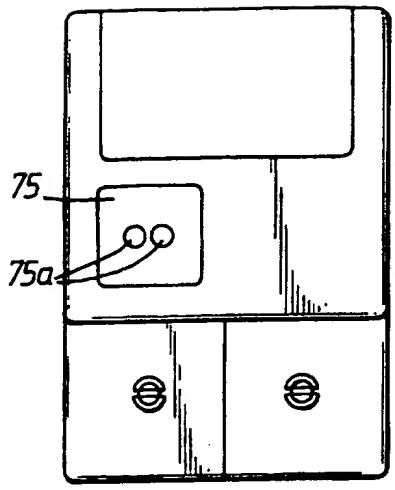

Fig.4a

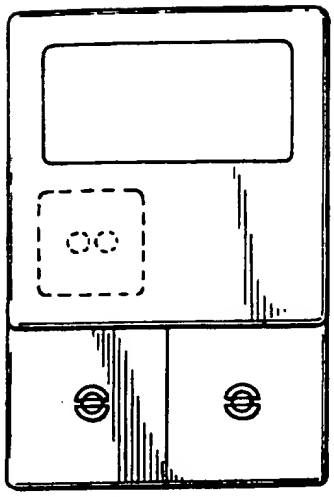

Fig.4c

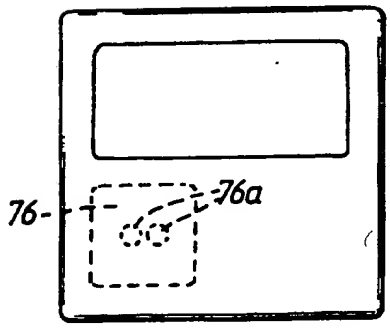

Fig.4b

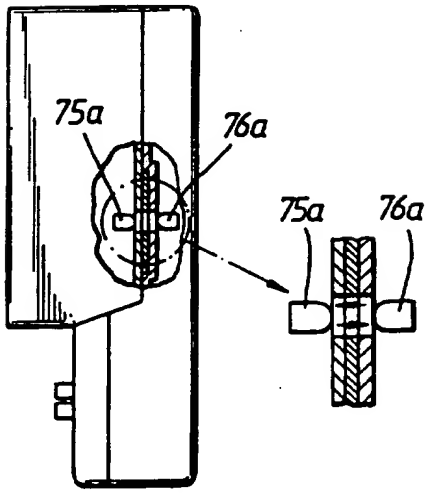

Fig.4d

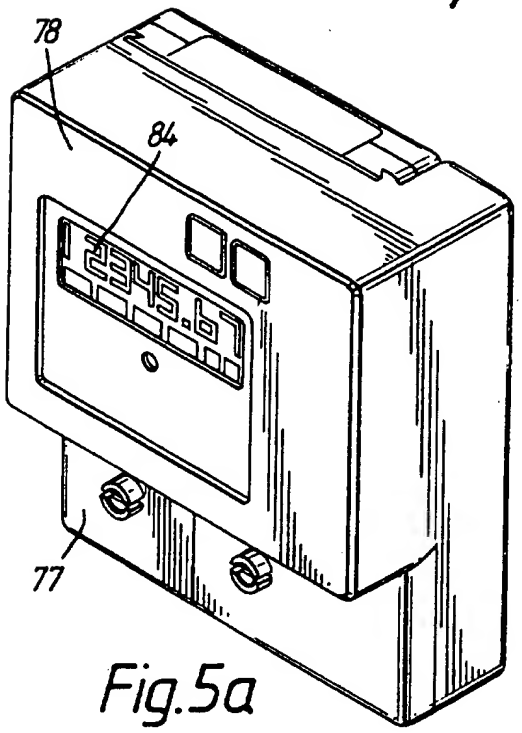

Fig.5a

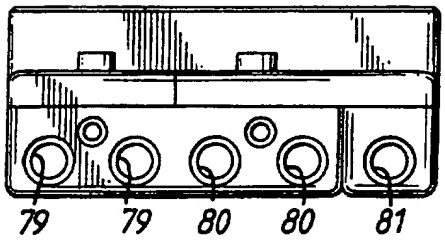

Fig.5c

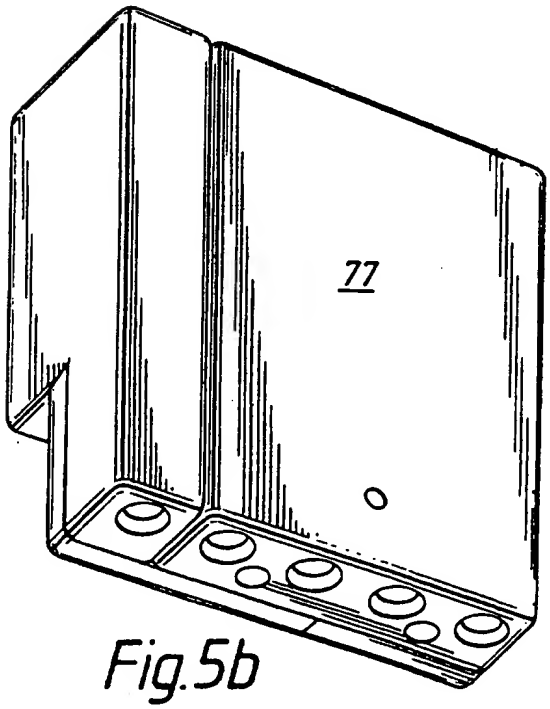

Fig.5b

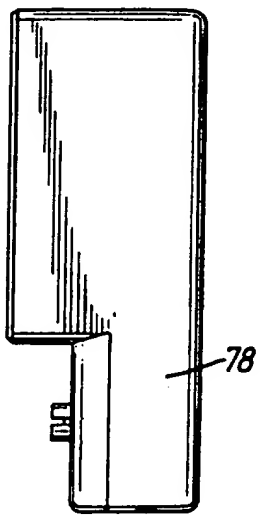

Fig.5d

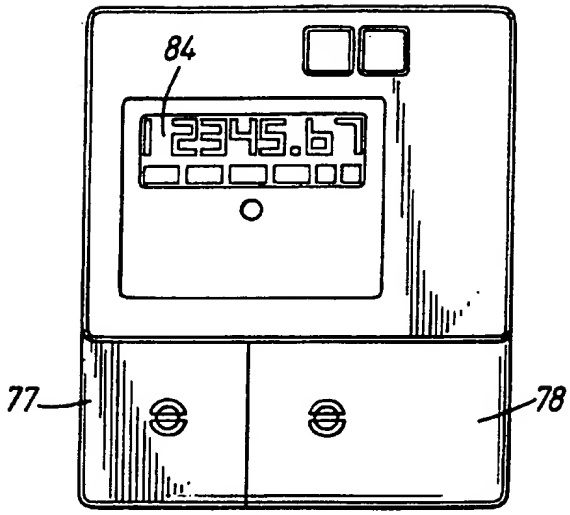

Fig.5e

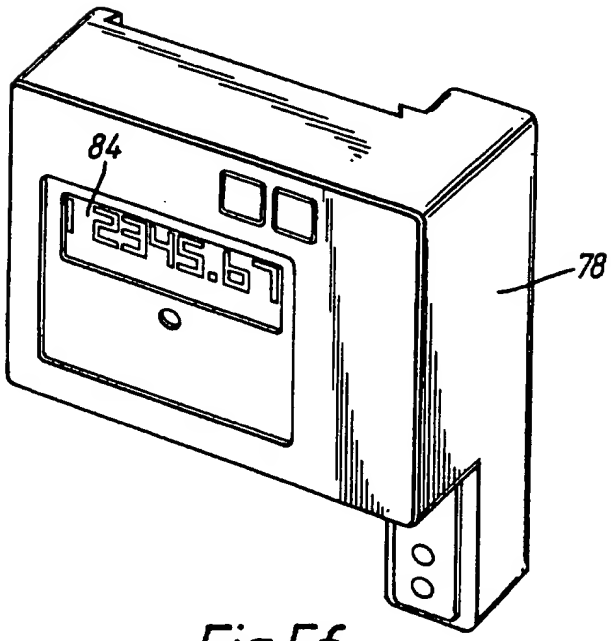

Fig.5f

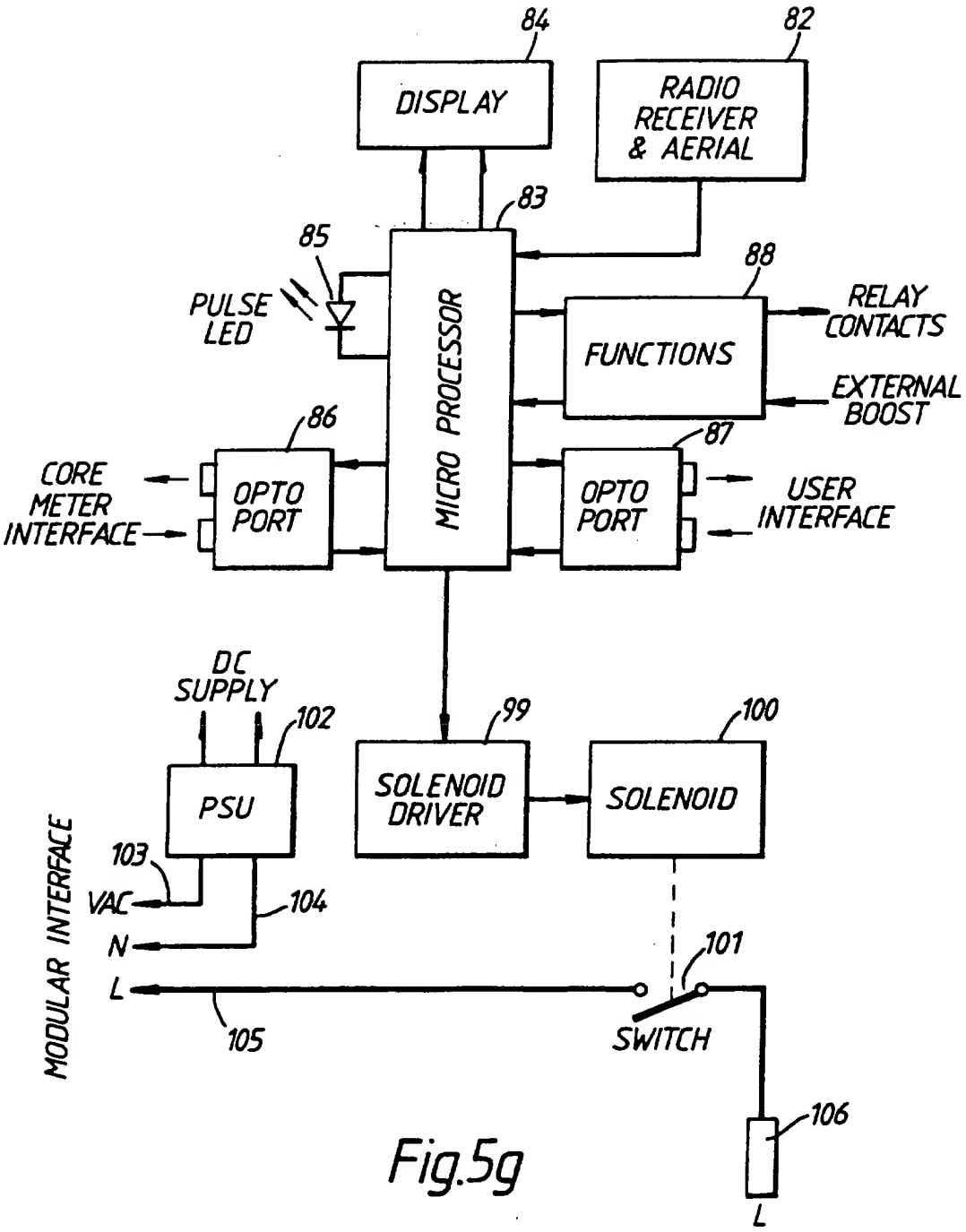
84
DISPLAY
82
RADIO RECEIVER & AERIAL
83
85
PULSE LED
MICRO PROCESSOR
88
FUNCTIONS
RELAY CONTACTS
EXTERNAL BOOST
86
CORE METER INTERFACE
OPTO PORT
87
OPTO PORT
USER INTERFACE
DC SUPPLY
102
PSU
99
SOLENOID DRIVER
100
SOLENOID
MODULAR INTERFACE
103
VAC
104
N
L
105
101
SWITCH
106
L

Fig.5g

IMPROVEMENTS IN OR RELATING TO ELECTRICITY METERS

This invention relates to electricity meters and more especially but not exclusively it relates to electricity meters for use by domestic consumers.

A standard electricity credit meter for domestic consumers simply provides a read-out of electricity used. Such meters are read periodically by a meter reader and a bill for the electricity used is sent to the consumer.

Alternatively, a pre-payment meter may be provided for domestic consumers which is arranged to provide a predetermined quantity of electricity to a value corresponding to the value of coins or tokens inserted into the meter.

Further alternatives comprise meters which are arranged to be interrogated remotely via a line link or a radio link for billing purposes and/or meters which can be controlled remotely for effecting tariff changes or for switching the supply on or off in accordance with the time of the day for example.

In these latter cases, a separate dedicated supply may be provided which is controlled remotely or in accordance with signals provided locally by means of a clock.

For the foregoing and other uses, different meters are available, each designed and constructed to suit the particular application in view. It is apparent that in order to provide for all possibilities a wide range of different meters are required. With known meters, this requirement has a number of attendant

disadvantages, including the high cost of changing from one meter system to another as well as the cost involved in fabricating different meters for different purposes which may each have the same basic functionality.

It is an object of the present invention to provide a versatile meter in which the aforesaid disadvantages are at least partly obviated.

According to the present invention an electricity meter comprises input terminals to which in use a mains electricity supply is connected, output terminals via which in use electricity is fed to a consumer, a switch via which electricity is fed from the input terminals to the output terminals and metering means operative to provide an indication of the quantity of electricity fed via the switch to the consumer, the meter being adapted to receive a unit arranged in operative association with the switch so as to effect operation of a switch actuator to open the switch for the purpose of interrupting the supply of electricity to the consumer consequent upon receipt by the unit of a predetermined actuation signal.

The switch actuator may form a part of the unit and may be arranged to co-operate mechanically with a switch assembly in the meter of which the switch forms a part, so as to effect operation of the switch consequent upon receipt by the unit of said actuation signal.

The switch actuator may be responsive to a further predetermined signal (which may simply be generated by removal of the said predetermined actuation signal), for effecting

switch operation so that the supply is connected/re-connected to the consumer.

The unit may be adapted to convert the meter to a pre-payment meter and may be arranged to receive coins or tokens or the like, in dependence upon the provision of which coins or tokens, electricity is supplied via the switch to the consumer, the unit being arranged to deliver the actuation signal to effect switch operation for the purpose of interrupting the supply of electricity to the consumer when a quantity of electricity appropriate to the value of coins or tokens received has been used by the consumer.

The unit may be electrically coupled to the meter for the purpose of receiving signals therefrom indicative of the quantity of electricity used.

Alternatively, the unit may be optically coupled to the meter for the purpose of receiving signals therefrom indicative of the quantity of electricity used.

The unit may have a display which provides an indication of electricity supplied to the consumer as measured by the meter.

Alternatively, the unit may have its own display and measurement facilities.

As a further alternative the unit may be adapted to facilitate the use of a display which forms a part of the meter for providing an indication of the quantity of electricity used by a consumer.

The unit may be arranged to facilitate remote meter reading.

The unit may include for the purpose of facilitating remote meter reading a line communication interface or alternatively a radio communication interface.

Alternatively or additionally, a line communication interface or alternatively a radio communication interface may be provided for effecting remote operation of the meter switch. Thus, it may be arranged that when payment tokens are purchased or, an outstanding bill paid, for example at a central office or showroom, the meter switch can be substantially immediately operated to connect or re-connect a supply.

The unit may include a further switch via which additional output terminals are fed which further switch may be operated remotely.

Alternatively the further switch may be locally controlled as by means of a clock.

It will be appreciated, that by providing a meter which includes a switch, to which meter additional unit(s) may optionally be fitted to operate the switch, a particularly cost effective and versatile meter may be provided in which installation expenses are minimised since additional functionality may be afforded quite simply by adding a unit to suit the function required, and whereby construction costs can be reduced by for example arranging that basic meter functionality is contained within the meter only.

Some embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, in which,

FIGURE 1a is an isometric view of an electricity meter;

FIGURE 1b is a bottom view of the electricity meter shown in Figure 1a;

FIGURE 1c is a side view of the meter shown in Figures 1a and 1b;

FIGURE 1d is a front view of the meter shown in Figure 1a;

FIGURE 1e is an isometric view of a part of the meter shown in Figure 1a;

FIGURE 1f is a block schematic circuit diagram of the meter as shown in Figures 1a to 1e;

FIGURE 2a is an isometric view of an assembly comprising the meter as shown in Figures 1a to 1e with a module unit fitted thereto;

FIGURE 2b is a bottom view of the assembly shown in Figure 2a;

FIGURE 2c is a side view of the assembly shown in Figure 2a;

FIGURE 2d is a front view of the assembly shown in Figure 2a;

FIGURE 2e is a front perspective view of a module forming part of the assembly shown in Figure 2a;

FIGURE 2f is an underside perspective view of the module shown in Figure 2e;

FIGURE 2g is a schematic block circuit diagram of the module shown in Figure 2f as used for pre-payment purposes;

FIGURE 2h is a schematic block circuit diagram of the module shown in Figure 2f as used as a telephone module;

FIGURE 3a is a front view of the meter which is a part of the assembly as shown in Figures 2a, 2b, 2c and 2d, and which includes a cut away portion to reveal a switch;

FIGURE 3b is a front view of a module unit forming a part of the assembly shown in Figures 2a, 2b, 2c and 2d, which includes a cut away portion to reveal a switch actuator;

FIGURE 3c is a front view of the assembly shown in Figure 2a having a cut away portion to reveal a switch and an associated actuator;

FIGURE 3d is a front view of the assembly shown in Figure 2g with the switch in a different position;

FIGURE 4a is a front view of a meter which corresponds largely to the meter shown in Figure 1a;

FIGURE 4b is a front view of a module for use with the meter shown in Figure 4a showing an optical interface;

FIGURE 4c is a front view of an assembly comprising the meter shown in Figure 4a having the module shown in Figure 4b fitted thereto;

FIGURE 4d is a side view of the assembly shown in Figure 4c together with an enlarged view of an optical interface which forms a part of the assembly;

FIGURE 5a is an isometric view of an assembly comprising a meter and a radio receiver and load switching module;

FIGURE 5b is a rear isometric view of the assembly shown in Figure 5a;

FIGURE 5c is a bottom view of the assembly shown in Figure 5a;

FIGURE 5d is a side view of the assembly shown in Figure 5a;

FIGURE 5e is a front view of a module which form a part of the assembly shown in Figures 5a to 5d;

FIGURE 5f is a front perspective view of a module which form a part of the assembly shown in Figures 5a to 5e, and,

FIGURE 5g is a generally schematic block circuit diagram of the module shown in Figure 5a.

Referring now to Figures 1a to 1e wherein corresponding parts of the various Figures bear where appropriate the same numerical designations, an electricity meter comprises a housing 1 which includes apertures 2 and 3 for input conductors from a mains supply and apertures 4 and 5 for output conductors which supply electricity to a consumer. Additional apertures 6 and 7 are provided for earth conductors. Terminals for securing the conductors are provided within the housing 1, which embody conductor fixing screws 8 and 9, as shown in Figure 1e, which are arranged to be accessible externally of the housing 1 for conductor fixing or removal purposes. The screws 8 which are used to secure the mains input conductors are covered with a cover 10 and similarly the screws 9 which are used to secure the output conductors are covered by means of a cover 11. The covers 10 and 11 are held in place by means of fixing screws 12 and 13 which engage complementary tapped holes 14 and 15 respectively. The covers 10 and 11 are sealed in place by means of wires 16 and 17 which pass through upstanding collars 18 and 19 respectively, which form a part of the covers 10 and 11. In order to prevent tampering, the wires 16 and 17 are sealed in position by means of seals 20 and 21. As shown in the circuit diagram of Figure 1f, the meter housing contains apparatus comprising input terminals 22 and 23 for the mains input conductors, and output terminals 24 and 25 which are arranged to feed electricity to a consumer from the

input terminals 22 and 23 via a switch 26. In order to measure the power consumed, signals appertaining to the supply voltage are fed to a measurement circuit 27 via conductors 28 and signals appertaining to the current supplied which is developed in a current sensing element 29, connected in series with the switch 26, are fed to the measurement circuit 27 via conductors 30. Output signals from the measurement circuit 27 are fed to a micro processor 31 which feeds a digital display 32. The micro processor 31 is fed also from a miscellaneous functions circuit 33 which may receive external signals appertaining to rate control and/or fraud detection, for example. Output signals from the micro processor 31 are fed to an LED 34 and omnidirectionally to an opto input and output port 35 which serves as a user interface via which information in the form of light signals may be extracted from the micro processor 31 or injected into the micro processor 31 for various purposes. In order to provide power for the measurement circuit 27, the miscellaneous functions circuit 33, the micro processor 31 and the display 32, a dc power supply 36 is provided which is fed from the conductors 28.

The switch 26 forms part of a switch assembly which includes an actuator 37, as shown in Figure 1e, which facilitates manual operation of the switch 26 when the cover 11 is removed. As shown in Figure 1e, an access port 38 is provided in the housing which is normally closed by means of a cover 39 (Figure 1a), the cover 39 being held in position by the cover 11. The port 38 provides access to live neutral and switch conductors 42, 41 and 40 respectively, as shown in Figure 1f, via an electrical socket connector (shown in

Figure 2f), and an access aperture 43 for a switch actuator pin 49 as will hereinafter be described with reference to Figure 2f.

Although the meter thus far described may be used alone as a standard credit meter, with the port cover 39 (Figure 1a) in position, it may be alternatively used in association with various modules to provide a meter assembly which has additional functionality.

One such module which may either comprise a pre-payment module or a telephone module as will now be described with reference to Figures 2a to 2h, wherein parts corresponding to the meter shown in Figure 1a bear the same numerical designations.

Referring now to Figure 2a to 2d, a meter assembly comprises the meter housing 1, as shown also in Figure 1a, having fitted thereto a module 44 which is formed to include dove tail slots 45 which co-operate with corresponding dove tail portions 46 of the meter as shown in Figure 1a and Figure 1e. The module 44 may thus be slid onto the meter housing 1, lockingly to engage therewith until pins 47 of an electrical connector 48 engage with complementary sockets in the access port 38 of the housing 1, whereby the module is arranged to make contact with the conductors 40, 41 and 42 as shown in Figure 1f, the conductor 40 and the terminal 25 being arranged to carry heady load current. Additionally, a switch actuator pin 49 enters the access aperture 43, as shown in Figure 1e, so that the switch 26 may be operated by the module 44. It is arranged that the optical interface 35 in the housing 1 aligns with a corresponding optical interface 50 in the module 44 when the module is fitted to the housing.

The module 44 may be arranged to perform a number of functions in accordance with the facilities required, electronic circuitry being provided to satisfy the requirement. For example, the module 44 may be designed to serve as a pre-payment module wherein input apertures 51 and 52 are provided for card-keys, smart-keys, smart-cards or memory-keys. Such a system is shown in the schematic block diagram of Figure 2g wherein a customer interface unit 53 is provided for a card-key or a smart-card or the like. Input signals from the interface unit 53 are fed to a micro processor 54 which provides signals for a display 55, an opto port 56, a pulsed LED 57 and a solenoid driver 58. A dc power supply 59 is provided for operating the various parts of the module. The solenoid driver 58 is arranged to operate a solenoid 60 (or an alternative electro-mechanical device, to perform a similar function) in accordance with signals provided from the micro processor 54 to control operation of the switch 26 by appropriate operation of the actuator pin 49. Thus it may be arranged that when a predetermined quantity of electricity has been supplied to a consumer, as determined by insertion of a key-card or smart-card or the like, into the customer interface unit 53, the switch 26 will be operated thereby to interrupt the electricity supply to the consumer.

In an alternative arrangement, the module 44 may be provided with electronic circuitry corresponding to the circuitry as shown in the block schematic diagram of Figure 2h. In this arrangement, the module 44 is connected to telephone lines 61 via a modem 62, which feeds a micro processor 63. A micro processor 63 is fed from a user interface opto port 64 and a meter interface opto port 65 as well as

from a pulsed LED 66. Information appertaining to electricity used is indicated by a display 67. As will be appreciated by those skilled in the art the functionality of the unit will be determined in accordance with the application required and for example, the meter may be remotely interrogated to determine the quantity of electricity used to provide for automatic billing. Additionally, or alternatively, applied signals from the telephone line 61 may be fed via the micro processor to control a solenoid driver 68, in accordance with the quantity of electricity used for example, whereby a solenoid 69 is activated so as to operate the switch 26 for the purpose of connecting or disconnecting a consumer as the case may be. A dc supply unit 70 is provided which provides operating power for the solenoid driver in the micro processor, the display and other parts of the circuitry as required. It will be appreciated that electrical communication between the unit shown in Figure 2g and the conductors 41 and 42 will be via conductors 71 and 72 respectively, and similarly the arrangement of Figure 2h is fed via conductors 73 and 74.

For a better understanding of the manner in which solenoids 60 and 69 (which may be other equivalent electro-mechanical devices) in Figures 2g and 2h respectively operate the switch 26, further explanation will now be provided with reference to Figures 3a to 3d.

Referring now to Figure 3a, the meter comprising the housing 1 includes a switch assembly which includes the switch 26 having associated with it the access aperture 43 as shown in Figure 1e for the actuator pin 49. As shown in Figure 3b the module 44, as shown in Figure 2a, includes a solenoid corresponding to the solenoid 60 for

example, having an actuator pin 60a. When the unit 44 is fitted to the housing 1, the actuator pin 60a aligns with the actuator 26a as shown in Figure 3c, whereby when the solenoid 60 is energised, the pin 60a is constrained to open the switch 26.

In order to facilitate a better understanding of the arrangement of the opto couplers in the housing 1, and the unit 44, reference will now be made to Figures 4a to 4d, wherein it can be seen that an opto port corresponding to the opto port 35 of Figure 1a is arranged to align with the opto port 50 of a module unit as shown in Figure 2f and thus an opto coupler 75 aligns with a corresponding opto coupler 76, so that active elements 75a and 76a respectively align to facilitate the transmission of light therebetween.

Although as hereinbefore described, the module unit may be arrange to operate a switch which is contained in the meter, alternatively, or additionally, the module unit may include its own switch as will now be described with reference to Figure 5a to 5g, wherein corresponding parts bear the same numerical designations.

Referring firstly to Figures 5a to 5f, a meter assembly comprises a meter housing 77 to which a radio module 78 is fitted having apertures 79 and 80 for input and output cables respectively, but additionally, the module unit provides an additional output aperture 81 for a further output conductor. The unit is arranged to include a radio receiver module 82, as shown in the circuit diagram, Figure 5g, which feeds a micro processor 83 connected to a display unit 84. As hereinbefore described, the micro processor feeds pulsed LED 85 and opto ports 86 and 87, data appertaining to additional functions being fed to the micro processor via a miscellaneous

functions circuit 88. In operation, the meter may be switched in dependence upon received radio signals via the micro processor 83 which appropriately operates a solenoid driver 99 which feeds a solenoid 100. Operation of the solenoid causes a switch 101 to operate so as to connect or disconnect as the case may be, power to a conductor 106 which enters the additional port 81. In order to provide power to the various units, a dc power supply 102 is provided, electrical connection between the module unit 78 and parts within the meter housing 77 being made as hereinbefore described via conductors 103, 104 and 105.

In the present example the switch 101 corresponds to the switch 26, shown in Figure 1f, but in alternative arrangements, a further switch may be provided in the radio module which may be arranged to be independently operated.

It will be appreciated that the foregoing embodiments are given by way of example only, and that various modifications may be made as will be appreciated by those skilled in the art, without departing from the scope of the invention.

CLAIMS

1. An electricity meter comprising input terminals to which in use a mains electricity supply is connected, output terminals via which in use electricity is fed to a consumer, a switch via which electricity is fed from the input terminals to the output terminals and metering means operative to provide an indication of the quantity of electricity fed via the switch to the consumer, the meter being adapted to receive a unit arranged in operative association with the switch so as to effect operation of a switch actuator to open the switch for the purpose of interrupting the supply of electricity to the consumer consequent upon receipt by the unit of a predetermined actuation signal.

2. A meter as claimed in Claim 1, including the unit.

3. A meter as claimed in Claim 1 or Claim 2, wherein the switch actuator forms a part of the unit and is arranged to co-operate mechanically with a switch assembly in the meter of which the switch forms a part, so as to effect operation of the switch consequent upon receipt by the unit of said actuation signal.

4. A meter as claimed in Claim 1, 2 or 3, wherein the switch actuator is responsive to a further predetermined signal for effecting switch operation so that the supply is connected/re-connected to the consumer.

5. A meter as claimed in any of Claims 2 to 4, wherein the unit is electrically coupled to the meter for the purpose of receiving signals therefrom indicative of the quantity of electricity used.

6. A meter as claimed in any of Claims 2 to 4, wherein the unit is optically coupled to the meter for the purpose of receiving signals therefrom indicative of the quantity of electricity used.

7. A meter as claimed in any of Claims 2 to 6, wherein the unit includes a display which provides an indication of electricity supplied to the consumer as measured by the meter.

8. A meter as claimed in any of Claims 2 to 6, wherein the unit includes its own display and measurement facilities.

9. A meter as claimed in any of Claims 2 to 6, wherein the unit is adapted to facilitate the use of a display which forms a part of the meter for providing an indication of the quantity of electricity used by a consumer.

10. A meter as claimed in any of Claims 2 to 9, wherein the unit is adapted to convert the meter to a pre-payment meter and is arranged to receive coins or tokens or the like, in dependence upon the provision of which coins or tokens, electricity is supplied via the switch to the consumer, the unit being arranged to deliver the actuation signal to effect switch operation for the purpose of

interrupting the supply of electricity to the consumer when a quantity of electricity appropriate to the value of coins or tokens received has been used by the consumer.

11. A meter as claimed in any of Claims 2 to 10, wherein the unit is arranged to facilitate remote meter reading.

12. A meter as claimed in Claim 11, wherein the unit includes for the purpose of facilitating remote meter reading a line communication interface.

13. A meter as claimed in Claim 11, wherein the unit includes for the purpose of facilitating remote meter reading a radio communication interface.

14. A meter as claimed in any of Claims 2 to13, wherein a line communication interface is provided for effecting remote operation of the switch.

15. A meter as claimed in any of Claims 2 to 13, wherein a radio communication interface is provided for effecting remote operation of the switch.

16. A meter as claimed in any of Claims 2 to 15, wherein the unit includes a further switch via which additional output terminals are fed.

17. A meter as claimed in Claim 16, wherein the said further switch is controllable locally by means of a clock.

18. A meter as claimed in any preceding Claim, wherein the said switch is locally controllable by means of a clock.

19 A meter as claimed in Claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

20. A unit for a meter as claimed in any preceding Claim and substantially as hereinbefore described with reference to the accompanying drawings.

21. In combination, a meter and unit as claimed in Claim 2 and substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977 Exa er's report to the Comptroller under Section 17 (The Search report)	Application number GB 9424461.3
Relevant Technical Fields (i) UK Cl (Ed.N) G1V VR1100, VR1102, VR1104, VR1124, VR1156, VR1157, VR1158 AND VR2200 (ii) Int Cl (Ed.6) G01R 11/00, 11/02, 11/04, 11/24, 11/56, 11/57, 11/58 AND 22/00	Search Examiner KEN LONG Date of completion of Search 28 FEBRUARY 1995
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) NONE	Documents considered relevant following a search in respect of Claims :- 1 TO 21

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Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2272530 A	(GENERAL ELECTRIC) note page 1 lines 3 to 6; page 2 lines 5 to 11 and 21 to 28; page 3 lines 3 to 6, 16 to 24 and 31 to 33 and page 4 lines 25 to 29	1, 2, 4-6, 10, 11, 12 and 15-18
X	GB 2087572 A	(GRANADA) note page 1 lines 71 to 73, 85 to 87 and 100 to 107	1, 2, and 10
X	GB 1204111	(LONDON ELECTRICITY) note page 1 lines 32 to 73, page 2 lines 59 to 84 and page 3 lines 28 to 47	1, 2, 4, 5, 7, 9-11, 14 and 18

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